

instead, it asks the Commission to use the "national average auction price." APC Argument Request at 11. But there is no reason why a license for one of the Nation's major metropolitan areas -- Washington/Baltimore (or Los Angeles for Cox and New York for Omnipoint) -- should be calculated from the price of a license for Worland, Wyoming. The value of a license depends not just on the population, but also on population density and economic activity. Consequently, the best way to measure the value of the pioneer's license is to look to the price paid for the other MTA license for the pioneer's region.<sup>12</sup>

(c) Incredibly, APC also relies on the Commission's decision to set aside licenses for and provide bidding credits to various designated entities. See APC Argument Request at 8-9. APC seems to assert that it cannot compete with other large corporations unless it receives its license for free -- even though small businesses owned by minorities and women must make do with much smaller discounts. To even state the argument is to refute it. APC, backed by the resources of the Washington Post, hardly can be said to suffer from the lack of access to capital that, in the Commission's view, justifies set asides and preferential treatment of designated entities. See Fifth Report and Order, supra, at

---

<sup>12</sup>It is possible, as APC contends, that the withdrawal of one license from the auction (so the pioneer can have it) will inflate the price of the remaining MTA somewhat. If APC is concerned this will occur, it can always surrender its license in advance and bid for it in the market. Or better still, the Commission can give pioneers their award as a \_\_\_ percent bidding credit instead of a guarantee of a license conditioned on payment of market price, or give the pioneers a choice between the two. See Hausman Aff. at ¶ 26.

¶¶ 97-103. Indeed, to the extent a comparison to designated entities is relevant, it demonstrates that APC is being treated far more generously than is warranted. While designated entities must compete among themselves for much smaller BTA licenses, APC presently has an enormous MTA license reserved for it alone -- an overly generous award the Commission should also reconsider at this juncture.

**II. The Commission Must Reconsider, in Light of Changed Circumstances and the Public Interest, its Decision to Award MTAs to the Preference Recipients**

Attempting to have its cake and eat it too, APC contends that the Commission should not reconsider its decision to give pioneers licenses encompassing entire regions (MTAs) rather than more modest licenses encompassing only one metropolitan area (BTAs). See APC Argument Request at 12 n.15. But the Commission must reconsider the scope of the awards because the sole factual predicate for the Commission's decision -- the unavailability of a 30 MHz block in the BTA markets -- has been eliminated by a subsequent change in the channel plan.

At the time of the Commission's decision on the awards, BTA licenses could only be awarded in either 10 or 20 megahertz blocks of spectrum. Because the Commission was "not convinced that a 20 megahertz BTA grant would be adequate, given the nature of the systems proposed," it had no choice but to give the pioneers MTAs; no 30 MHz BTAs existed.<sup>13</sup> This is no longer the case. On June 9,

---

<sup>13</sup>Bell Atlantic and Pacific Bell continue to believe that this conclusory and unsupported statement cannot constitute a finding that the systems would not work in less than 30 MHz. Indeed, any

1994, the FCC amended its PCS channel plan to provide for one 30 MHz license and three 10 MHz licenses in each BTA. Memorandum Opinion and Order, Amendment of the Commission's Rules to Establish New Personal Communications Services, FCC No. 94-144, Gen. Docket No. 90-314 (released June 13, 1994) at ¶ 33. As a result of this change, a 30 MHz license could now be granted to the preference winners for a single BTA, even assuming that a 30 MHz award is truly necessary to operate their systems. In addition, the Commission can now aggregate 3 10 MHz BTAs and award the aggregate to the pioneers. Because this change eliminates the Commission's rationale for not giving the pioneers BTA licenses, the Commission must reconsider its decision.

A. Now that the Commission can award the pioneers each a 30 MHz BTA or an equivalent, it is clear that the Commission should. The Commission's entire rationale for giving the pioneers anything at all is reliance. But the pioneers could not have relied on receiving MTAs, as the geographic scope of licenses had not been resolved at the time the pioneers filed their preference requests. More important, it is clear that the pioneers did not rely on receiving regional licenses, for they requested only licenses for metropolitan areas. Omnipoint sought a license to serve the "Northern New Jersey area" -- thirteen counties in the Newark area.

---

such finding would be contrary to the record, including APC's claim that its FAST technology -- which formed a basis for APC's award -- could be used "with any relatively narrowband PCS system . . . employing a channel bandwidth of 5 megahertz or less." Third Report and Order, Amendment of the Commission's Rules to Establish New Personal Communications Services, 9 FCC Rcd 1337, 1340, ¶ 16 (1994) ("Awards Order") (emphasis added).

The FCC, however, guaranteed Omnipoint a regional market more than **ten times** that size, including New York City, the entire state of Connecticut, and parts of Vermont. Similarly, although APC requested a preference for the Washington/Baltimore area, APC received a regional MTA license encompassing territory from West Virginia to the Eastern Shore, including all of Maryland and parts of Virginia running as far south as Lynchburg. And when Cox applied to serve the "San Diego metropolitan area,"<sup>14</sup> the Commission gave it approximately half of California (including Los Angeles), half of Nevada and part of Arizona. See Awards Order, 9 FCC Rcd at 1349, ¶ 80. Surely Cox, which received an award based on its use of cable systems, could not have relied on receiving a license that covers vast areas where it has no cable interests whatsoever.<sup>15</sup>

Moreover, the Commission made it clear in its Tentative Decision that the parties should not rely on receiving a regional license. There, the Commission stated that if it adopted a service area scheme that separated Washington and Baltimore (i.e., BTA service areas), it would "permit APC to elect which service area it desires." Tentative Decision and Memorandum Opinion and Order, Amendment of the Commission's Rules to Establish New Personal Communications Services, 7 FCC Rcd 7794, 7799 n.11 (emphasis added).

---

<sup>14</sup>Cox, Request for an Award of Pioneer Preference 1 (May 4, 1992).

<sup>15</sup>Indeed, as an alternative to the single San Diego license, Cox requested licenses in cities in which it had a majority interest in a cable system. Ibid. Nowhere in its request did Cox ask for or justify the award of any region in which it did not own a cable system.

Indeed, the Commission warned the pioneers not to rely on the size of their awards even after the Commission announced the Final Awards. See Awards Order, 9 FCC Rcd 1337, 1338, at ¶ 2 (1993) ("Should either PCS channel blocks or service areas be amended on reconsideration, the pioneer's preferences will be amended accordingly" (emphasis added)). Given that the pioneers sought licenses only for metropolitan markets in their original license applications -- and that the Commission offered them no reason to expect anything else -- "reliance interests" cannot justify a decision to give the pioneers licenses for areas ten times that size. See Nalebuff Decl. at ¶ 15; see also Hausman Aff. at ¶ 18; Milgrom Aff. at ¶ 10.

In any event, to the extent there are reliance interests, they must be balanced against the competitive consequences of giving away such an enormous award.<sup>16</sup> Allocating the largest and most valuable license to preference awardees achieves no such balance. As Professor Hausman explains, "the current reward structure" leads "to the maximum amount of economic inefficiency because it" uses "the largest band size (30 MHz) and the largest geographical areas (an MTA). If a license is to be granted to pioneers despite the fact that they are unlikely to be the most socially efficient user, the smallest band size and smallest geographical area would likely lead

---

<sup>16</sup>See 47 U.S.C. § 309(j)(3)(B); 6 FCC Record at 3492, ¶ 34 (declining to give pioneers a "head start" on providing service in response to comments that a temporary monopoly would create unfair competition); RCA Communications, 346 U.S. at 94 ("[t]here can be no doubt that competition is a relevant factor in weighing the public interest").

to a significantly decreased amount of economic inefficiency from the current plan." Aff. at ¶ 19. Commissioner Ness has pointed this out as well: "[T]he adverse effects of awarding a single party a license without payment increase as the value of the license itself increases." Mtel Order (separate statement).

B. APC does not dispute the significance of giving it an MTA rather than a BTA. Instead, its primary strategy is to argue that BTAs are inferior to MTAs as a general matter. PCS licensees, it contends, will fail unless they have coverage that competes with cellular systems, and rural areas will not obtain effective service unless they share facilities with urban areas. APC Further Comments at 5-6. This could be overcome by creating alliances with other Block C BTA parties, APC admits, but doing so would be significantly slower and more difficult than with regional licenses, it alleges. Id. at 7.

To the extent any of these things are true, they are irrelevant. Any purchaser of a BTA license will face those very same hurdles, and APC offers no reason to think that it uniquely would suffer as a result of receiving a BTA. Indeed, if APC and the other pioneers truly have innovative technology to offer, they should prove more effective at creating the necessary alliances and overcoming these handicaps than other possible BTA licensees.

As a back-up argument, APC contends that giving it just Washington or Baltimore would "cleave" a naturally integrated market. Again, APC cannot complain about this, because even in the Tentative Decision the Commission warned that APC might well receive

a license for only one of those BTAs. More important, there is no reason that APC cannot arrange a partnership with whatever entity buys the other half of the Washington/Baltimore area. If such an arrangement is economically rational, there is little reason to doubt it will be concluded. Moreover, because APC's partner would be a designated entity, giving APC a BTA would be socially desirable. APC, with its "innovative" technology and Washington Post backing, should prove a very helpful ally for the smaller entity with which it would become associated.

Attempting to assert the interests of the designated entities, APC expresses concern that giving the pioneers block C BTAs might lock deserving designated entities out of the San Diego and Washington, D.C. Block C markets.<sup>17</sup> It is ironic that APC would argue that a 30 MHz BTA is such a raw deal while simultaneously decrying any move that might deny a designated entity the chance to obtain the same license. In any event, with 493 30 MHz BTAs available, shifting a couple should not produce a substantial impact on designated entity participation -- especially when compared to the anticompetitive effect of misallocating 3 of the most valuable MTAs in the nation. But the Commission does not even have to consider this difficulty, since it can also aggregate 3 10 MHz BTAs for each of the preference recipients, thereby minimizing the impact on the designated entities and on competition at the same time. Any claim that certain pioneers need an MTA could, in any event, be

---

<sup>17</sup>That Omnipoint would receive a Northern New Jersey BTA is irrelevant, as Omnipoint is small business that would be entitled to purchase that license at auction in any event.

addressed through other rules tailored to prevent unjust enrichment and anticompetitive effects. The Commission could, for example, offer the preference winner the option of choosing between a guaranteed BTA (with payment of appropriate compensation) or the right to receive bidding credits toward the purchase of an MTA.<sup>18</sup>

### Conclusion

APC's proposal that the pioneers receive their licenses for free would have a substantial and adverse impact on competition and grossly overcompensate the pioneers for any reliance interests they might have. Imposing a payment requirement, however, will reduce the adverse competitive effects and ensure that the pioneers are not unjustly enriched. Although a bidding credit of not more than 10

---

<sup>18</sup>APC also has submitted a highly unusual request for oral argument. If the Commission believes that argument would be helpful and not delay decision, Pacific Bell and Bell Atlantic Personal Communications would not object, so long as they and the broadband pioneers are given equal time. Nonetheless, APC's rationale for having argument -- the unsubstantiated assertion that "[t]he Commission has never before raised" the competitive implications of giving pioneers their licenses for free "and has entertained no comment on it," APC Argument Request at i -- is incorrect. The Commission expressly raised the issue. Notice of Proposed Rule Making, Review of the Pioneer's Preference Rules, 8 FCC Rcd 7692, 7693, ¶ 11 & n.11 (1993); Comments of Omnipoint Communications, Inc. at 2 (Nov. 15, 1993) ("[T]he Commission asked . . . whether [to] charge for a license obtained through the pioneer's preference process"). And party after party, including broadband pioneers, commented on it. See, e.g., Comments of Cox Enterprises, Inc., at 11 (Nov. 15, 1994); Reply Comments of Omnipoint Communications, Inc. at 13-18 (Nov. 22, 1993); Comments of Pacific Bell and Nevada Bell at 2 (Nov. 15, 1993); Comments of Nextel Communications at 8-9 (Nov. 15, 1993); Comments of PageMart, Inc. at 6 (Nov. 15, 1993); GTE Comments at 4 (Nov. 15, 1993); Comments of Southwestern Bell Corporation at 5-6 (Nov. 15, 1994); Comments of Paging Network, Inc. 13-14 (Nov. 15, 1993). In any event, now that APC has supplemented the record with a barrage of unsolicited pleadings, it cannot justify argument by complaining about the state of the record.




percent will best achieve the Commission's desired balance between competition and perceived reliance interests by the guarantee of a license (conditioned on payment of something approximating market rate) is also superior to giving away the licenses for free. In addition, the Commission should reduce the size of the awards since the current awards exceed anything on which the pioneers might have relied and maximize the adverse impact on competition.

GARY M. EPSTEIN  
MAUREEN E. MAHONEY  
JAMES H. BARKER  
LATHAM & WATKINS  
Suite 1300  
1001 Pennsylvania Ave., N.W.  
Washington, D.C. 20004

WILLIAM L. ROUGHTON  
1310 N. Courthouse Rd.  
Fifth Floor  
Arlington, VA 22201  
*Attorneys for Bell Atlantic  
Personal Communications, Inc.*

Respectfully submitted,

  
MICHAEL K. KELLOGG  
JEFFREY A. LAMKEN  
KELLOGG, HUBER, HANSEN & TODD  
1301 K St. N.W.  
Suite 305 East  
Washington, DC. 20005

JAMES P. TUTHILL  
MARGARET deB. BROWN  
JEFFREY B. THOMAS  
140 New Montgomery St.  
Rm. 1522-A  
San Francisco, CA 94105

JAMES L. WURTZ  
1275 Pennsylvania Ave., N.W.  
Washington, D.C. 20004  
*Attorneys for Pacific Bell*

August 1, 1994

A

Before the  
FEDERAL COMMUNICATIONS COMMISSION  
Washington, D.C. 20554

Attachment  
RECEIVED

AUG - 1 1994

RECEIVED  
FEDERAL COMMUNICATIONS COMMISSION  
WASHINGTON, D.C. 20554

Affidavit of Paul R. Milgrom

1. My name is Paul R. Milgrom. I am the Shirley and Leonard Ely, Jr. Professor of Humanities and Sciences and Professor of Economics at Stanford University in Stanford, California, 94305. My background and experience are set forth in my November 8, 1993 affidavit which was attached to the comments of Pacific Bell and Nevada Bell filed November 10, 1993 in the P.P. Docket No. 93-253 in the Matter of Implementation of Section 309(j) of the Communications Act (Competitive Bidding). My curriculum vitae is attached as Exhibit A.

2. I have been asked by Pacific Bell and Nevada Bell to review and comment upon the affidavit filed by John Gould and Gustavo Barnberger in support of American Personal Communications Supplemental Comments on Remand regarding the Review of the Pioneer's Preferences Rules, filed July 26, 1994.

SUMMARY AND CONCLUSIONS

3. I find that (1) the Gould-Barnberger affidavit makes elementary errors in its economic analyses and that its principal conclusions are incorrect. I have also reached the following conclusions. (2) Requiring recipients of pioneer preference awards to pay 90% of the price of a comparable license sold at auction would be likely to improve the efficiency of the license assignment and of the pioneer awardees' technology decisions — thereby enhancing competition in the PCS markets — while also providing a reward that is more nearly comparable in value to the awardees' research investments. (3) The economic efficiency of the license assignment process would be further enhanced if, rather than granting the pioneer preference awardees an option to

purchase the assigned license for 90% of the auction price of a comparable license after the close of the auction, the Commission instead awarded them a bidding credit of 10% of the price of any licenses acquired in the relevant major trading area. The awardees could then participate in the auction on the same terms as other bidders and could use those credits for other licenses in the relevant MTA, which would promote a more efficient assignment of licenses and consequently more intense competition in the PCS market.

#### I. ERRORS IN THE GOULD-BARNBERGER ANALYSIS

4. The Gould-Barnberger affidavit concludes that: "Because awarding APC, Cox and Omnipoint licenses at no charge will have no effect on their actions, it will have no effect on the competitive environment faced by potential bidders for broadband PCS licenses, and thus will not 'distort' any future bidding for licenses."<sup>1</sup> Both the premise and the conclusion of this statement are incorrect. The premise is incorrect, first, because a zero price charged to the awardee for its license would distort its decision about whether to acquire a license and, if so, which license to acquire. A license that is attractive at a zero price might not be so if the awardee were required to pay a price equal to 90% of the auction price of a comparable license. In ascending bid auctions such as those planned for the broadband MTA licenses, the auction price is just high enough to exclude the last losing bidder, and therefore is approximately equal to the value of the license to that losing bidder. Consequently, an unwillingness on the part of the awardee to pay 90% of that price indicates that the awardee's value of the license is at least 10% less than that of at least one losing bidder. In such a case, competition and efficiency would both be significantly enhanced if the license were instead placed in the hands of one of the losing bidders.

5. Even if the pioneer preference awardee's value for the license is high enough to pay for the license, a still better license assignment might entail assigning the

---

<sup>1</sup>Paragraph ¶18.

awardee a different, and perhaps smaller geographic area or spectrum bandwidth. At a zero price, the awardee would naturally prefer to receive one of the large MTA licenses, even when the smaller BTA licenses within the major trading area represent a more efficient choice, because the awardee would eventually be able to sell the MTA license for much more than the BTA license.

6. When a pioneer preference award leads the awardee to acquire an MTA license that it would not otherwise have acquired, this distortion is likely to be multiplied by its effect on the bidding for related licenses. The Commission's recent determination that the broadband licenses are "significantly interdependent"<sup>2</sup> highlights the importance of this effect. The award might lead bidders who had hoped to build a system of licenses including New York or Washington-Baltimore or Los Angeles to alter their business and bidding plans for all of the related licenses. In addition, the pioneer preference awardee may be tempted to use its own license as part of a broader system, exploiting its advantage to the detriment of other bidders. These scenarios are made more likely by the restrictions associated with the preference awards, which limit the resale of the license to companies planning larger networks and which force the awardee to employ a technology that may not fit well with those of bidders on related properties.

7. Even if none of the cited distortions were present, charging a zero price could significantly affect other business decisions. To the extent that the recipients of pioneer preference awards have limited financial resources, charging a zero price for the assigned licenses would add directly to the firm's equity capital, which would in turn expand its debt capacity. That change would alter the likely level and timing of its various investment decisions. The awardee's ability to raise new capital would normally depend on its proprietary technologies, innovative prowess, business plan and general business reputation, but the zero price pioneer preference adds a new

---

<sup>2</sup>See Para. ¶31, Fifth Report and Order in P.P. Docket No. 93-253.

element – equity capital supplied by the largesse of the FCC. To the extent that the awardees have limited ability to raise capital on their own, the pioneer awards would both allow and encourage them to undertake investments that would otherwise be unprofitable or impossible.

8. Together, these observations mean that Gould and Barnberger are quite wrong to conclude that awarding pioneer licenses at a zero price would have no effect on a company's decisions. On the contrary, such an award would affect many of the company's decisions: It would make it likely that the company would participate in the PCS market to a greater extent than is consistent with the efficient use of the spectrum, that it would make larger and earlier investments than it might otherwise undertake, and that the company would adhere to its "pioneer" technology even if subsequent developments make that choice uneconomic. The result of assigning significant licenses to competitors that are less efficient than other potential competitors and preventing resale would be a reduction in competition in the PCS market.

9. The Gould-Barnberger affidavit also argues that if the Commission were now to change its decision about the pioneer preference awards, that would undermine the credibility of future government promises, which would "have a chilling and deleterious effect on the willingness for business to plan and invest in risky but potentially valuable research and development activities."<sup>3</sup> Beyond the hyperbole of this language and the affidavit's outlandish comparisons of the Commission's reconsideration process to the political instability of third-world countries,<sup>4</sup> the analysis is simply wrong. There is nothing inappropriate about the Commission seeking to reduce the size of the pioneer preference award if the award is too large,

---

<sup>3</sup>Paragraph ¶20.

<sup>4</sup>See Para. ¶20 of the Gould-Barnberger affidavit.

just as there would be nothing inappropriate about increasing the award if it were inappropriately small.

10. The correct version of this argument is that a government's commitment to maintain to fair, efficient and predictable processes contributes to economic prosperity by encouraging businesses to make investments. These processes can certainly include review procedures intended to adapt to changing circumstances or to correct errors in preliminary decisions. The introduction of auction authority and the division of the spectrum into larger geographical blocks are the events that most significantly altered the context surrounding pioneer preference awards. Before the introduction of the auction authority, the cost to government of a pioneer preference award was the foregone opportunity of assigning the license by lottery or administrative hearing — mechanisms that were hardly more likely than the pioneer award to assign the license to an efficient user. Since the introduction of the auction authority, however, the cost of licenses assigned outside the auction process includes both the loss of significant government revenues and a likely reduction in the efficiency of the assignment, with a consequent diminution of competition in the PCS industry. These costs are especially significant for the largest PCS licenses.

11. Of course, the government should be reluctant to reduce awards where doing so would damage its credibility by harming those that acted in reliance on the size of the promised award. In this case, however, the size of the awards was not announced before the investments were made by the pioneer awardees and, indeed, the pioneer preference program was under review when even tentative recipients were identified. Moreover, the fact that the pioneer awardees had all requested licenses covering less extensive geographical regions than were actually awarded indicates that the proposed MTA awards were larger than the awardees had expected. Under these circumstances, taking care to determine an appropriately scaled reward is entirely consistent with the kind of commitment that promotes business investment and economic efficiency.

## II. SETTING THE PRICE TO 90% OF THE AUCTION PRICE

12. In the Second Report and Order in P.P. Docket No. 93-253, the Commission listed the objectives of its license assignment process and concluded that it could “best achieve these objectives by generally awarding licenses to the parties that value them most highly.”<sup>5</sup> The analysis underlying this conclusion applies not only to the auction process, but also to the award of pioneer preferences. When such preferences are assigned at a zero price to awardees, the goal of awarding licenses to the parties that value them most highly can be seriously undermined. There is nothing in the process to ensure that the license is assigned to a company that values the licenses at even nearly the same amount as the best other companies. As explained above, charging a price to the awardee of 90% of the auction price of the license limits the inefficiency of the preference process by ensuring that the preference is exercised only if the awardee's value is close to that of the highest losing bidder.

13. Charging a price of 90% of the auction price introduces some of the advantages of a market assignment system into the pioneer award process, not only for the license assignment process but also for determining the award to innovators. In telecommunications as in other industries, the main reward for socially useful investments in new technologies is the success of those technologies in the marketplace. To the extent that businesses, by their investments, create knowledge that can be utilized by other businesses, encouragement in the form of an award can enhance economic efficiency. The size of the award should be proportionate to the size of the required investment and to the riskiness of that investment. Also, it should reward only that portion of the investment that enhances the values of other companies, rather than merely the business opportunities of the awardee.

14. American Personal Communications (APC) has reported, for example, that its efforts in developing PCS technology involved an investment “exceeding \$20

---

<sup>5</sup>Para. ¶173.



million.”<sup>6</sup> Only a fraction of this investment would have served to create knowledge that is valuable to other bidders, and even that fraction must be reduced by the value of the private benefits obtained by APC. Consequently, any award predicated on an assumed investment of \$20 million to benefit all companies in the industry would overcompensate APC.

15. The awards themselves consist of discounts on licenses in the Los Angeles, Washington-Baltimore and New York major trading areas. The value of the licenses set aside for the pioneers has been subject to various estimates, with recent estimates ranging from \$500 million to \$2 billion.<sup>7</sup> These estimates, for licenses that cover some 1,600 POP-MHz of spectrum, are likely to climb after the results of the just-completed narrowband auction are fully digested. In auctions completed on July 29, 1994, licenses for approximately 185 POP-MHz of narrowband spectrum drew bids totalling approximately \$617 million. If the prices of the broadband spectrum are proportionate, this would indicate a value for the pioneer preference awards in excess of \$5 billion. Even at the old estimates, a 10% discount from the auction price would allow the awardees to save an estimated \$50 million \$200 million – an amount in the same general range as the awardees' total investments. Much larger awards would be economically unjustified.

### III. BIDDING CREDITS

16. I have already explained that offering a license to a pioneer preference awardee for a price equal to 90% of the auction price of a comparable license is likely to lead to more efficient assignment of the licenses – and therefore to more

---

<sup>6</sup>American Personal Communications, Supplemental Comments on Remand: Page 2, footnote 1.

<sup>7</sup>“With Millions at Stake, Dingell Launches PCS Preference Inquiry,” FCC Report, May 19, 1994. See also Letter from William E. Kennard to the Hon. John D. Dingell 17 (June 3, 1994).

competition — than the alternative of awarding the license for a zero price. A still more efficient assignment of the licenses would result if the pioneer simply received a 10% bidding credit for the particular license.

17. The reasons for this conclusion are two. First, suppose that a pioneer awardee chooses not to exercise its option to acquire a license. If that choice is made after the close of the auction, the other bidders would have little opportunity to modify their plans to react to that choice. If, however, the pioneer is awarded a bidding preference for the specified license and chooses to exit from the bidding when the price becomes too high, then other bidders can adjust their plans to take advantage of the availability of that license.

18. The second reason is that a bidding credit that can be exercised for BTA licenses within the MTA would encourage the awardee to make that choice if the price of an MTA license becomes too high. The value created by a license assignment in which some awardee receives a BTA license might be higher than that created by an MTA award. This extra flexibility of the awardees during the bidding process would allow the auction fuller scope to determine the license assignments that create the greatest total value in the auction and best promote effective competition in the PCS market.

Respectfully submitted,

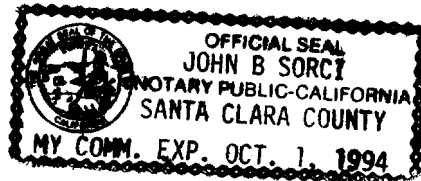
*Paul R. Milgrom*  
Paul R. Milgrom

Date: *30 July 94*

Subscribed and sworn to before me this 30 day of July, 1994.

*John B. Sorci*  
Notary Public

My Commission expires 1 OCT 94



CURRICULUM VITAE

**Paul Robert Milgrom**

823 Pine Hill Road  
Stanford, CA 94305  
(415) 424-8631 (Phone/Fax)

Economics Department  
Stanford, CA 94305  
(415) 723-3397  
(415) 725-5702 (Fax)

*Personal*

Born April 20, 1948 in Detroit, Michigan  
U.S. Citizen  
Married with two children

*Employment*

- 1987-      **Stanford University**  
Shirley R. and Leonard W. Ely, Jr. Professor of Humanities and Sciences  
(1993-)  
Professor of Economics (1987-)  
Director, Stanford Institute for Theoretical Economics (1989-91)
- 1986-87    **University of California - Berkeley**  
Ford Visiting Professor of Economics
- 1982-87    **Yale University**  
Williams Brothers Professor of Management Studies and Professor of  
Economics 1985-87  
Professor of Economics and Management 1983-85  
Visiting Professor 1982-83
- 1979-83    **Northwestern University**  
Kellogg Graduate School of Management  
Department of Managerial Economics and Decision Sciences  
Professor 1982-83  
Associate Professor 1981-82  
Assistant Professor 1979-81

- 1981        **Stanford University**  
Visiting Research Associate in Economics
- 1972-75    **Nelson and Warren, Inc.**  
Consulting Actuary
- 1970-71    **Metropolitan Life Insurance Co.**  
Actuarial Trainee

### *Education*

- 1975-78    **Stanford University**  
Ph.D. in Business, January 1979  
M.S. in Statistics, April 1978
- 1966-70    **University of Michigan**  
A.B. in Mathematics with high honors, May 1970

### *Honors, Awards, Prizes, Fellowships, Chairs and Grants*

- 1994        National Science Foundation research grant "Comparative Statics, Complementarities, Coordination and Change," covering 1994-1997. Woytinsky distinguished lecturer, University of Michigan.
- 1993        Senior Research Fellow, Institute for Policy Reform. Shirley R. and Leonard W. Ely, Jr. Professor of Humanities and Sciences.
- 1992        Fellow, American Academy of Arts and Sciences. International Guest Scholar, Kyoto University.
- 1991        Fellow, Center for Advanced Study in the Behavioral Sciences. National Science Foundation research grant "Theories of the Firm - 2" covering 1991-1994.
- 1990        Center for Economic Policy Research grant to study "The Economics of Modern Manufacturing."
- 1989        National Science Foundation grant to direct programs for the Stanford Institute for Theoretical Economics; National Academy of Sciences award to lecture in China on economics of organizations.

- 1988 Olin Distinguished Lecturer, Princeton University; National Science Foundation research grant "Theories of the Firm" covering 1988-91; Center for Economic Policy Research grant.
- 1987 Prize for Best Paper of the Year in the *Transactions of the Society of Actuaries*.
- 1986 Ford Visiting Professor of Economics, University of California-Berkeley; John Simon Guggenheim Fellowship to study "Economic Theories of Organization."
- 1985 Williams Brothers Chair in Management Studies, Yale University; National Science Foundation research grant "On the Formal Economic Theory of Organizations"; Fellow of the Institute for Advanced Studies, Hebrew University of Jerusalem; plenary lecturer at the Fifth World Congress of the Econometric Society.
- 1984 Fellow of the Econometric Society; Fellow of Morse College (of Yale University)
- 1983 Research Award, Actuarial Education and Research Fund; Honorary Master of Arts degree, Yale University
- 1982 National Science Foundation research grant to study "The Structure of Information in a Productive Organization."
- 1981 IBM Research Chair at Northwestern University
- 1980 Leonard J. Savage Memorial Thesis Award; National Science Foundation research grant: "Information and Uncertainty in Competitive Bidding."
- 1976 Society of Actuaries Triennial Paper Prize for best paper by an actuary within five of membership, for the period 1973-75.
- 1974 Fellow of the Society of Actuaries

### *Major Professional Activities and Affiliations*

- 1994-        Program Committee, 1995 World Congress of the Econometric Society
- 1993-        Senior Research Fellow, Institute for Policy Reform
- 1993-        Editorial Board, *Journal of Economics and Management Strategy*
- 1993-        Associate Editor, *American Economic Review*
- 1992-        Fellow, American Academy of Arts and Sciences
- 1990-93     Co-Editor, *American Economic Review*
- 1990-        Associate Editor, *Games and Economic Behavior*
- 1989-92     Associate Editor, *Journal of Financial Intermediation*
- 1987-90     Associate Editor, *Econometrica*
- 1985-89     Associate Editor, *Rand Journal of Economics*
- 1983-87     Associate Editor, *Journal of Economic Theory*
- 1984        Chair, Program Committee, Econometric Society Winter Meetings
- 1984-        Fellow, Econometric Society
- 1980-        Member, American Economic Association
- 1979-        Numerous lectures and visiting scholar positions at universities, research  
institutes and policy centers in Argentina, Belgium, Canada,  
England, France, Germany, Israel, Italy, Japan, Spain, Sweden,  
Switzerland, the United States, Uruguay, and Venezuela.

### *Selected Economic Consulting Experience*

- SRI, Inc. (Rexnord's expansion into Brazilian rock crusher market)
- Southern New England Telephone Co. (Financial valuation of perpetual service contract)
- Rand Corp (Evaluation of U.S. defense procurement practices)
- Arctic Slope Regional Corporation (FERC Hearings on Trans-Alaska Pipeline tariffs.  
Gave written testimony on economics of cost allocation and pricing.)
- Georgia Pacific (Great Northern Nekoosa merger/antitrust litigation)
- Exxon (Environmental damage assessment, Exxon Valdez oil spill)
- Bishop, Barry et. al. (Asbestos-related insurance litigation: Flintkote v Commercial Union. Testified as expert on economics of risk bearing)
- Pacific Bell Telephone (Advising the FCC on design of spectrum auctions)

## Publications

### *Books*

*The Structure of Information in Competitive Bidding* (Ph.D. Dissertation), New York: Garland Press, 1979.

*Economics, Organization and Management* (with John Roberts), Englewood Cliffs: Prentice-Hall, 1992.

*Instructor's Manual for Economics, Organization and Management* (with John Roberts, assisted by Nicolaj Siggelkow), Englewood Cliffs: Prentice-Hall, 1992.

### *Articles by Topic*

#### **Actuarial Science**

1. On Understanding the Effects of GAAP Reserve Assumptions, *Transactions of the Society of Actuaries*, 27, 1975, 71-88.
2. Measuring the Interest-Rate Risk, *Transactions of the Society of Actuaries*, XXXVII, 1985: 241-57.
3. Reply to the Comments on "Measuring the Interest Rate Risk," *The Transactions of the Society of Actuaries*, XXXVII, 1985: 297-302.

#### **Auctions and Competitive Bidding**

1. A Convergence Theorem for Competitive Bidding with Differential Information, *Econometrica*, 47, 1979, 679-88.
2. Rational Expectations, Information Acquisition, and Competitive Bidding, *Econometrica*, 49, 1981, 921-43.
3. The Value of Information in a Sealed Bid Auction (with Robert Weber), *Journal of Mathematical Economics*, 10, 1982, 105-14.



4. A Theory of Auctions and Competitive Bidding (with Robert Weber), *Econometrica*, 50, 1982, 1089-1122. (Reprinted in (1) *Game Theory in Economics*, edited by Ariel Rubinstein, London: Edward Elgar Publishing, 1990 and in (2) *The Economics of Information*, edited by Steven A. Lippman and John E. Anderson, London: Edward Elgar Publishing, 1994.)
5. Competitive Bidding with Proprietary Information (with Richard Engelbrecht-Wiggans and Robert Weber), *Journal of Mathematical Economics*, 11, 1983, 161-69.
6. The Economics of Competitive Bidding: A Selective Survey, *Social Goals and Social Organization: A Volume in Honor of Elisha Pazner*, edited by L. Hurwicz, D. Schmeidler and H. Sonnenschein, London: Cambridge University Press, 1985, Chapter 9, 261-89.
7. Auction Theory, *Advances in Economic Theory: Fifth World Congress*, edited by Truman Bewley, London: Cambridge University Press, 1987, 1-32.
8. Auctions and Bidding: A Primer, *Journal of Economic Perspectives*, 3, Summer 1989, 3-22.

### **Pricing Strategies**

1. Limit Pricing and Entry Under Incomplete Information: An Equilibrium Analysis (with John Roberts), *Econometrica*, 50, 1982, 443-59. (Reprinted in (1) *Industrial Organization*, edited by Oliver Williamson, London: Edward Elgar Publishing, 1990, and in (2) *The Economics of Information*, edited by Steven A. Lippman and John E. Anderson, London: Edward Elgar Publishing, 1994.)
2. Predation, Reputation, and Entry Deterrence (with John Roberts), *Journal of Economic Theory*, 27, 1982, 280-312.
3. Price and Advertising Signals of Product Quality (with John Roberts), *Journal of Political Economy*, 94, 1986, 796-821.
4. Predatory Pricing, *The New Palgrave: A Dictionary of Economic Theory and Doctrine*, J. Eatwell, M. Milgate, and P. Newman (eds.), London: MacMillan Press Ltd., 1988.